Development of a collective Thomson scattering system for laser-produced high-Z plasmas for soft X-ray light sources

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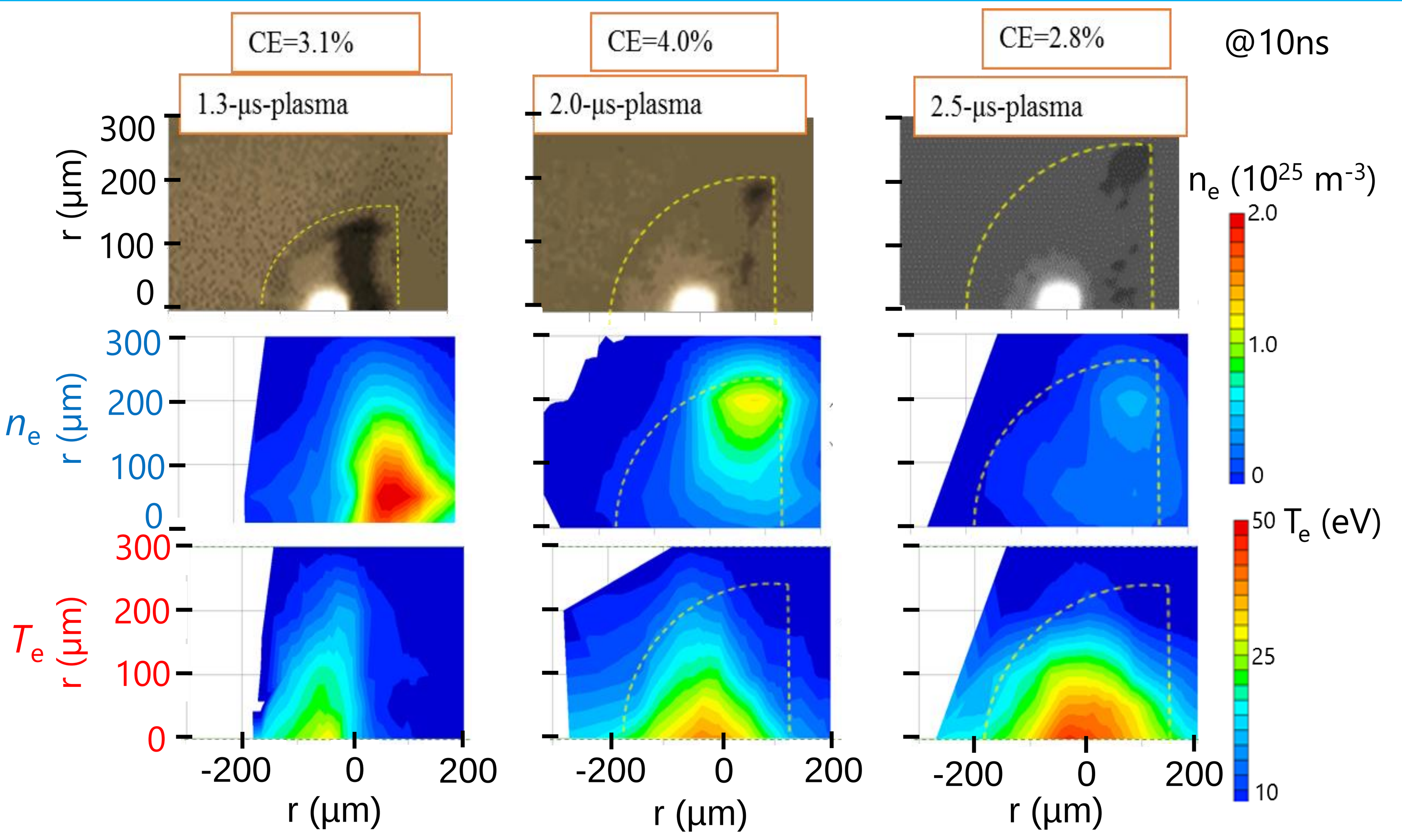
Past results (Case of EUV)

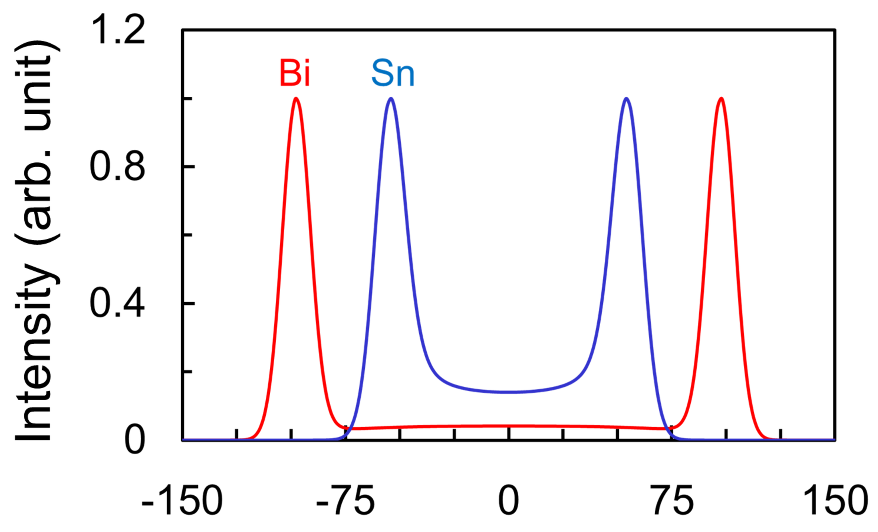


K. Tomita, Y. Sato, N. Bolouki, *et al.*, Applied Physics Express **8**, 126101 (2015)
Y. Sato, K. Tomita, S. Tsukiyama, *et al.* J. Jpn. J. Appl. Phys. , **56**, 036201 (2017)
K. Tomita, Y. Sato, S. Tsukiyama, *et al.*, Scientific Reports, **7**, 12328 (2017)

In the case of high-*Z* plasma

- **Ion term**
  - Intensity → n_e
  - Spectral width → $T_e \times Z$
  - ~~Spectral shape~~
- **Electron term**
  - Spectral width → n_e
  - Spectral shape → T_e

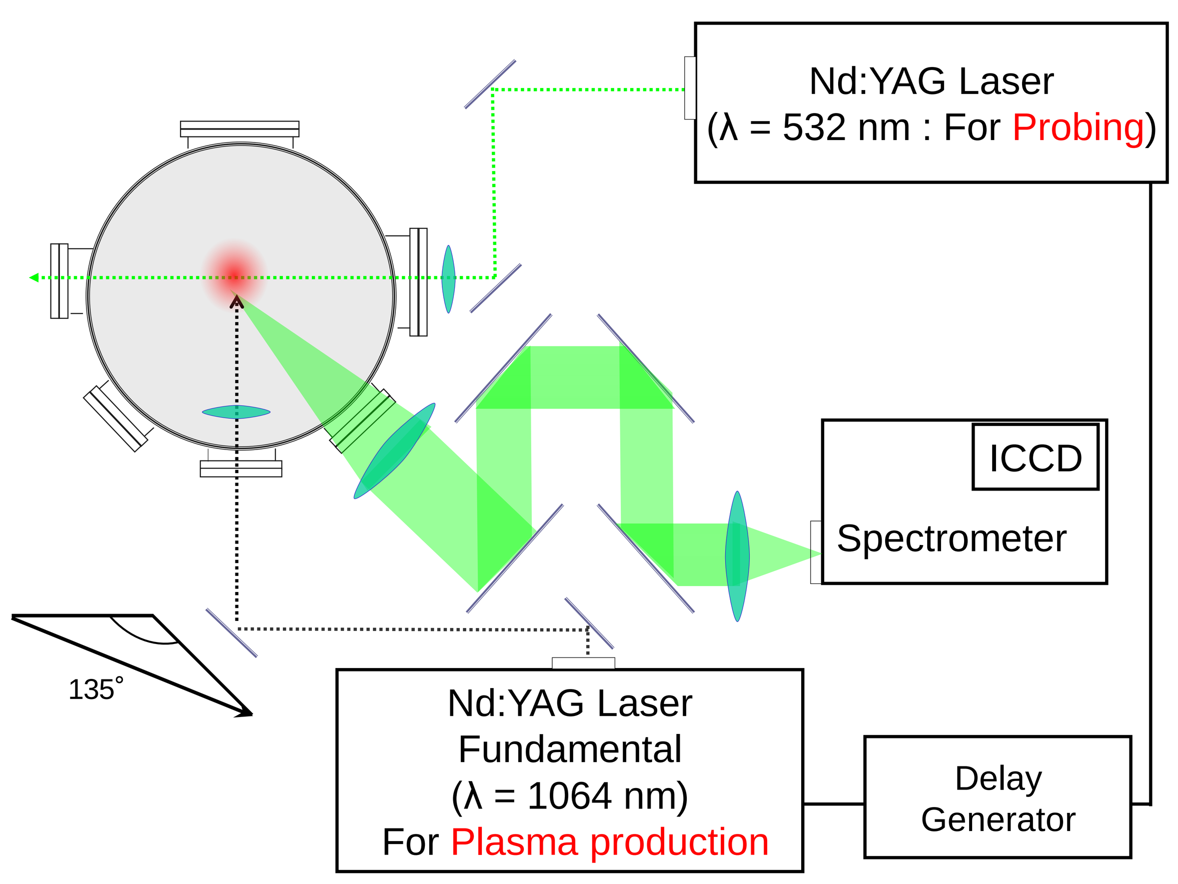
Measure n_e, T_e, Z from two terms



Expected ion term spectra
Sn for EUV
Bi for W-W

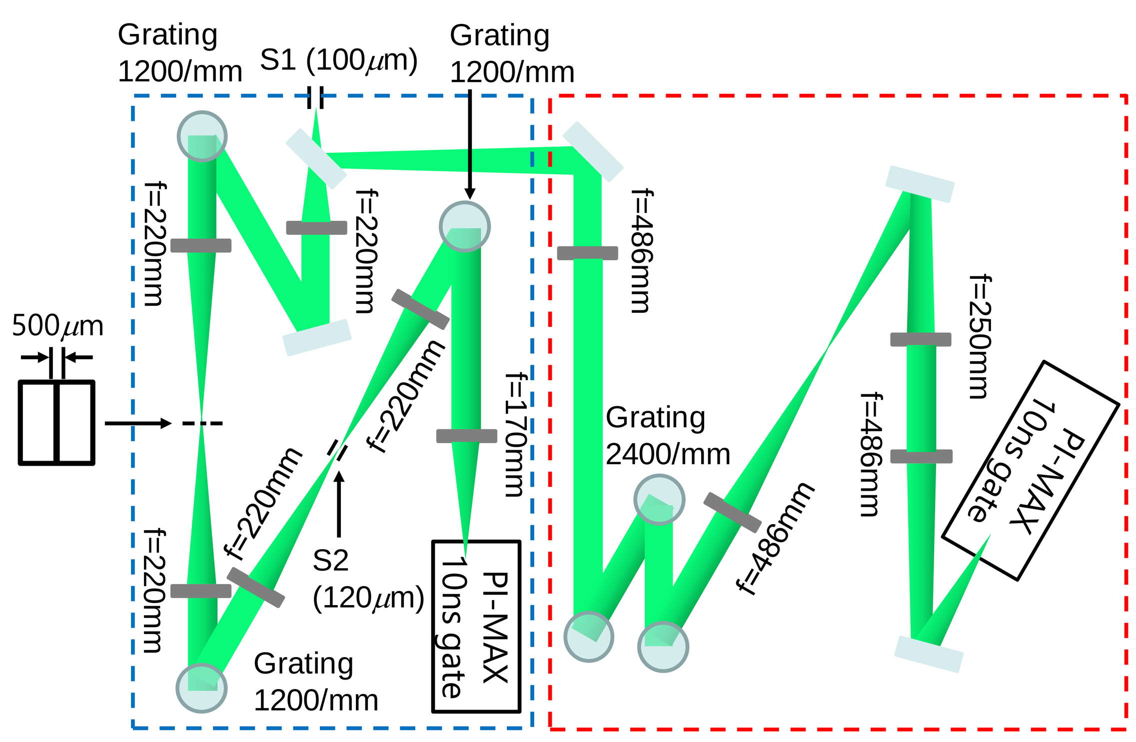
We tried to diagnose the helium break down plasmas to test a theory of Thomson scattering as a first step.

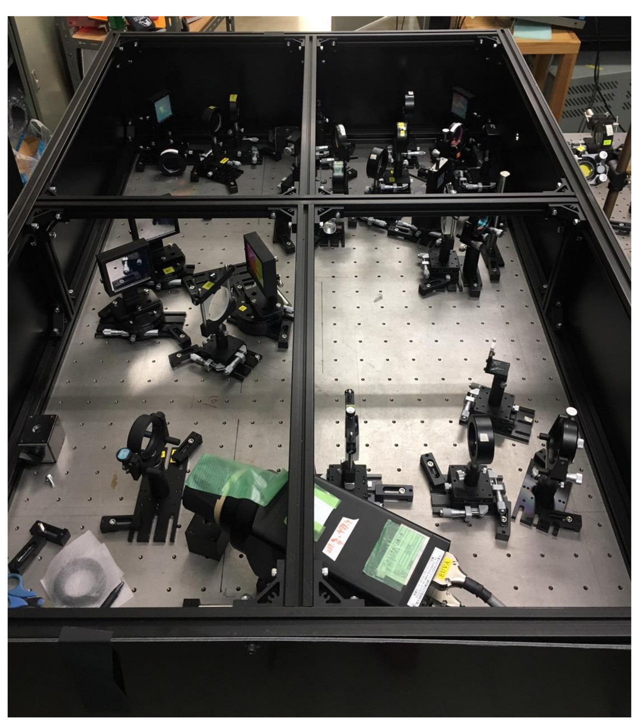
Experimental setup



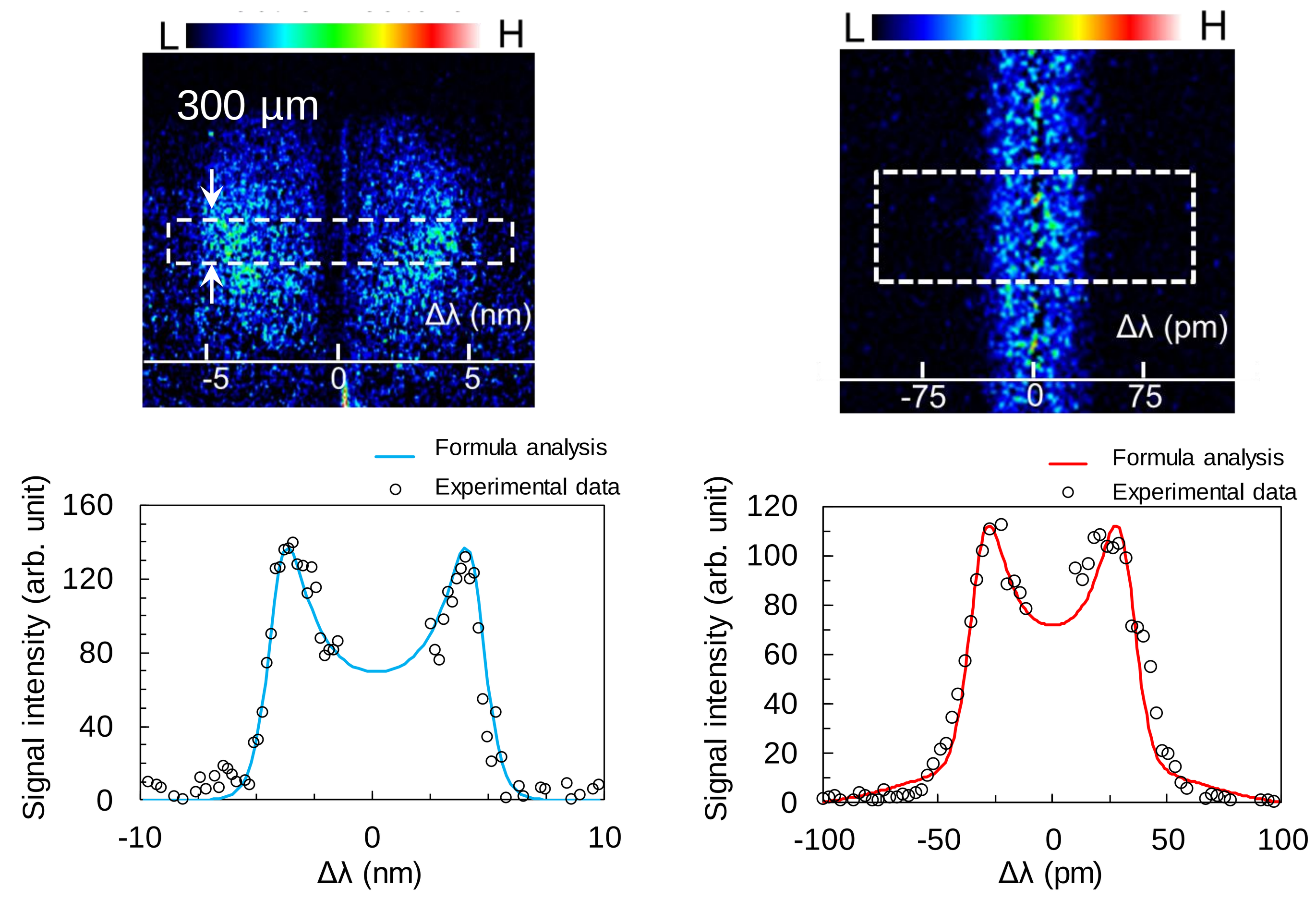
Conditions

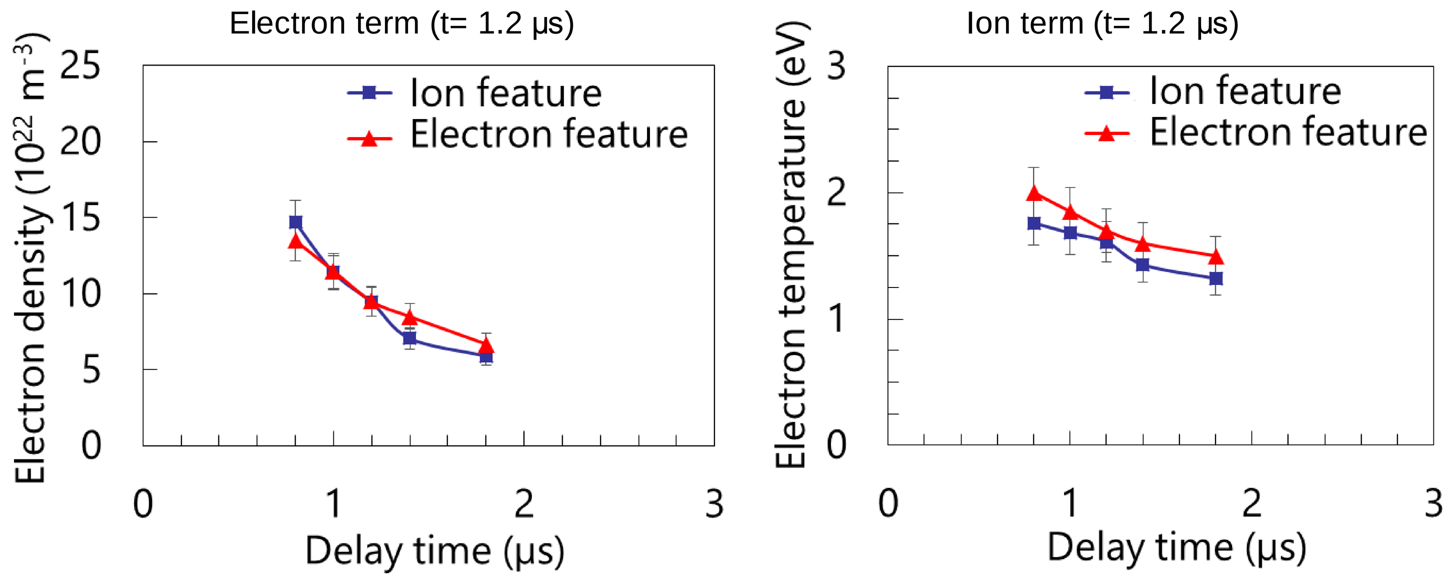
- Scattering angle : 135°
- Driving laser beam (Surelite)
  λ = 1064 nm
  E_p = 250 mJ
- Probing laser beam (Powerlite 9010)
  λ = 532 nm





Results and Discussions

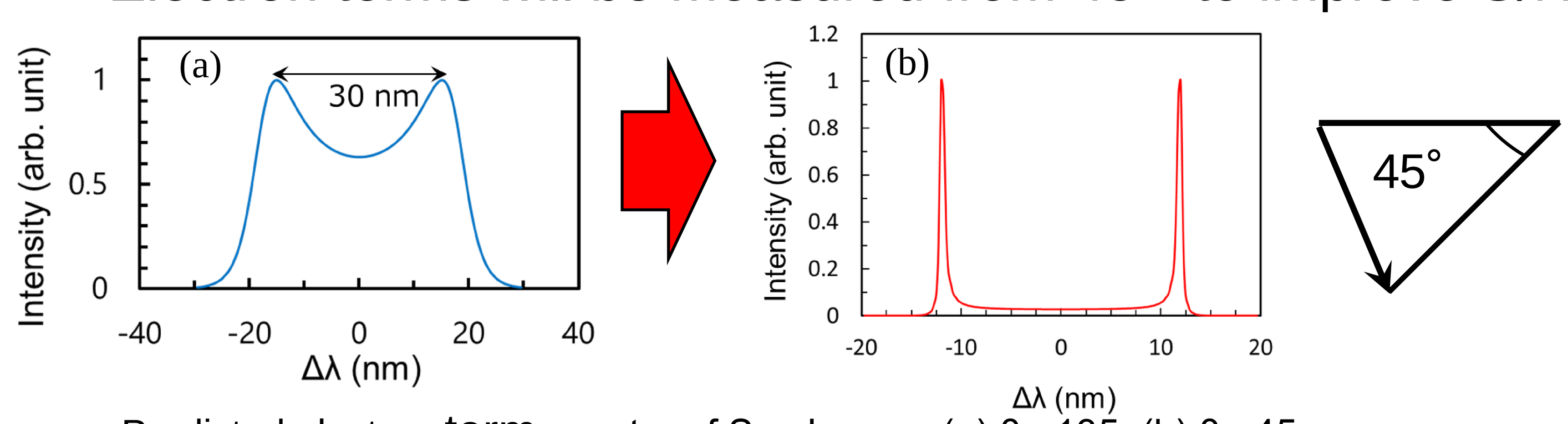




- This LTS system achieved to obtain same parameters from two terms.
- n_e accords with a past measurement result, but T_e is heated by probe laser.
- However the plasma for soft-X ray light has high-T_e, lager than 100 eV, therefore, the influence of the heating can be ignored.

For a measurement of Sn plasmas

- **Ion term**
  Already measurable as shown past results
- **Electron term**
  The greatest obstacle is self-emission of plasmas
  Electron terms will be measured from 45° to improve S/N



Predicted electron term spectra of Sn plasmas (a) θ= 135, (b) θ= 45

- Signal intensity per unit wavelength increases
- The intensity will be bigger than noise caused by self-emission
- This method can keep signal intensity by measurement from different directions

Conclusion

- We are developing a new LTS system for high-Z plasmas for soft-X ray light sources
- Our new LTS system obtained electron and ion terms of helium plasma and the spectra indicated same parameters.
- Now, we are measuring two spectra of Sn plasmas for soft-X ray light source plasmas.